MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 2, 2017/2018

EPM1016 – INSTRUMENTATION AND MEASUREMENT TECHNIQUES

(TE, RE, BE)

17 MARCH 2018
9.00 am – 11.00 am
(2 Hours)

INSTRUCTIONS TO STUDENTS

1. This Question paper consists of 6 pages including cover page with 4 Questions only.
2. Attempt **ALL FOUR** questions. All questions carry equal marks and the distribution of the marks for each question is given.
3. Please write all your answers in the Answer Booklet provided.

Question 1

(a) Explain the following terms:

(i) Measurement [2 marks]

(ii) Sensor [2 marks]

(iii) Nominal value [2 marks]

(b) Describe all three stages of generalized measurement system with the glass thermometer and named the most important device or materials.

[9 marks]

(c) The true value of a voltage is 1.50V. An analog indicating instrument with scale range of 0 – 2.50V shows a voltage of 1.46V. Estimate the following values of

(i) absolute error and correction.

(ii) Relative absolute error as a fraction of the true value and the full-scale deflection (f.s.d.). [4 marks]

(d) The moving coil of a PMMC milli-ammeter has 60 turns, a width of 20 mm and a depth of 30mm. The working field is uniform and radial, of value 50mT. The deflection produced for a current of 0.025A is 90°. Predict the following

(i) Deflecting torque of the coil when carrying a current of 2.5mA.

[3 marks]

(ii) Find the deflection of pointer for a current of I/4 amps, if the control torque is provided by Spring control

[3 marks]

Continued .....

Question 2

(a) A single-phase energy meter makes 500 revolutions per kWh. In a testing run it makes 50 revolutions in 45 seconds at 5kW full-load. Calculate the meter readings percentage error?

[4 marks]

(b) A balanced delta-connected load of (8+j6) Ω per phase is connected to a balanced 3-phase 400V supply. Calculate the following:

(i) The phase voltage [3 marks]

(ii) The phase current [3 marks]

(iii)The line current [3 marks]

(c) A dynamometer type wattmeter is connected to measure the power of a load in a single-phase circuit having a current of 2.5A and a voltage of 220V with a power factor of 0.75. If the resistances of the current and moving coils are 0.6Ω and 2.2kΩ respectively. Calculate:

(i) The error in the meter readings if the moving coil is connected before the current coil?

(ii) The error in the meter readings if the moving coil is connected after the current coil?

(iii) Design the possible ways of connection.

[12 marks]

Continued .....

Question 3

(a) Four resistors in a Wheatstone bridge as shown in the Figure **Q 3(a)** are given by: $R_1 = R_2 =$ 1 kΩ , R_3 = 1 kΩ and the adjustable resistance R_4 = 1.5kΩ. If the bridge's supply voltage is E=10V. Calculate the following

(i) The unbalance voltage (also called offset voltage), if a high-impedance voltmeter is used for the detector.

[8 marks]

(ii) The unbalance current, if a galvanometer of resistance 50Ω is used for the detector.

[12 marks]

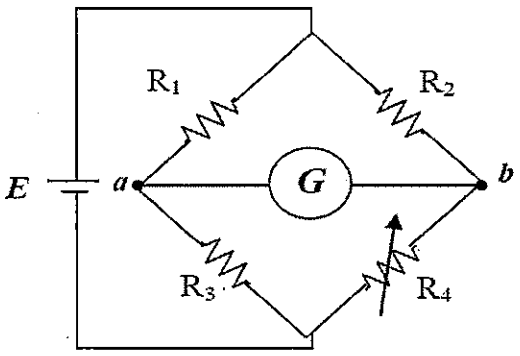

Figure Q3 (a)

(b) AC bridge is just the same as the Wheatstone bridge, except that impedances are used instead of resistances, and the supply is an ac-source. Also, the null detector must be an AC instrument. Categorize the required conditions to balance an AC bridge in mathematical form.

[5 marks]

Continued .....

Question 4

(a) A strain gauge with gauge factor of 2.54 is used in a bridge as shown in Figure **Q4 (a).** The bridge consists of two fixed resistor R3 and R4 of 120Ω each and a variable resistor R2 which is 100 Ω at zero strain and 100.75 Ω with strain at bridge null detection. Examine the strain, where the strain gauge is attached?

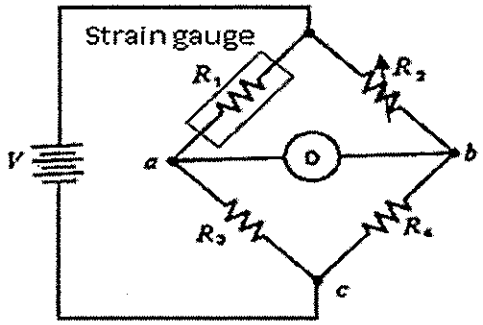

Figure Q4 (a)

[13 marks]

(b) The area of hysterics' loop for Barium strontium titanate (BST) magnetic material is 60 cm^2 and the scales of the graph on which is drawn are

H axis, 1 cm is 200 AT/m
B axis, 1 cm is 0.2 Wb/m^2

(i) Draw a model hysterisis curve for the above magnetic material.

(ii) Calculate the loss in watt/Kg. The frequency is 50Hz and the density of the material is 0.8 g/cm^3.

[12 marks]

End of Page

APPENDIX

$\delta A = A_m - A_t$

$\delta C = -\delta A$

$\epsilon = \delta A / A_t$

$Td = BINA$

$PL = V I \cos \phi$

$$V_{ab} = V_a - V_b = \left[\frac{R_3}{R_1 + R_3} - \frac{R_4}{R_2 + R_4} \right] V$$

$R_{TH} = R_1 \| R_3 + R_2 \| R_4 = (R_1 * R_3 / R_1 + R_3) + (R_2 * R_4 / R_2 + R_4)$

$Z_1 Z_4 = Z_2 Z_3$

$P_h = A * V * f$

$G = (\Delta R_1 / R_1) / K$